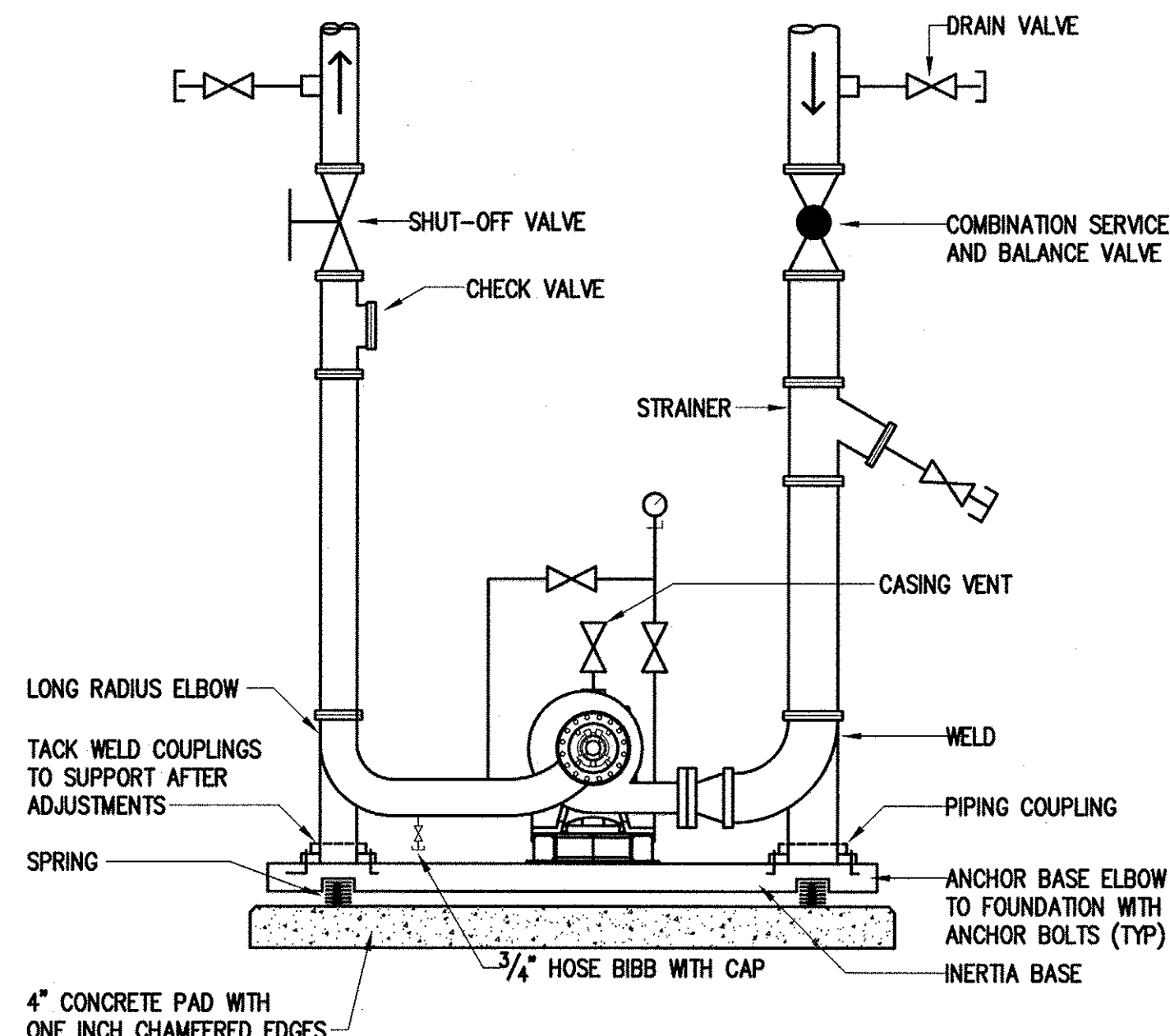


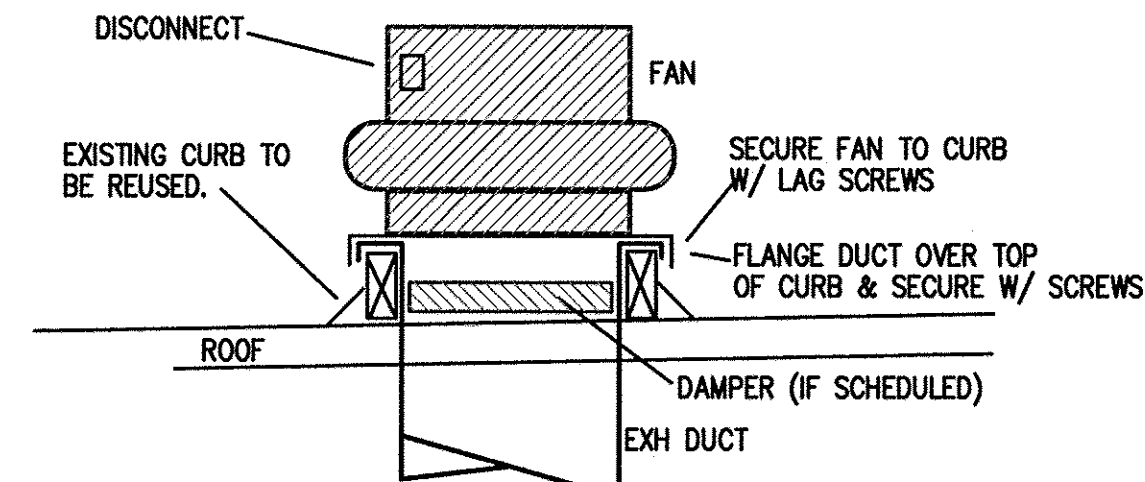
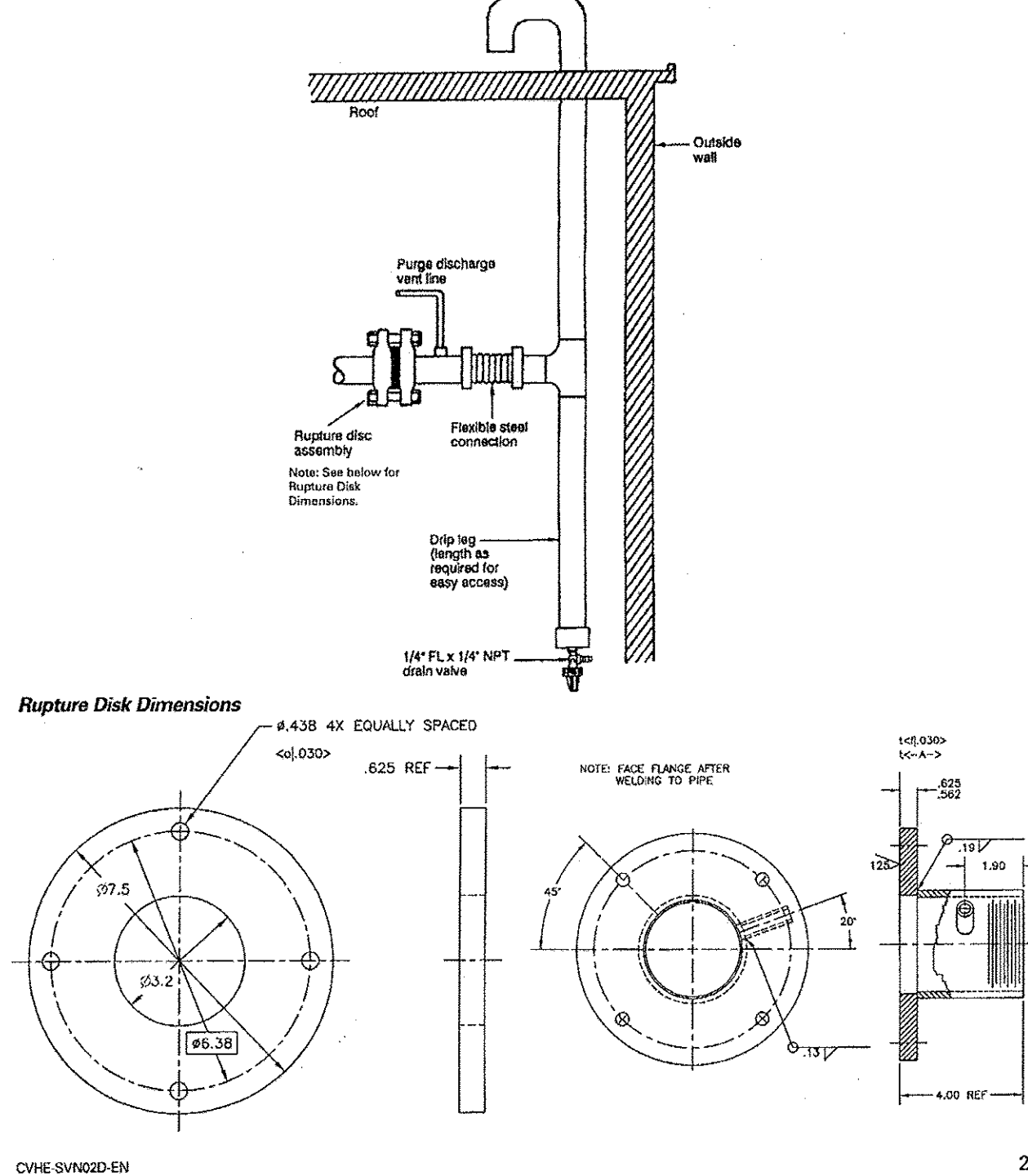
1 CENTRIFUGAL CHILLER PIPING CONNECTION DETAIL
NOT TO SCALE



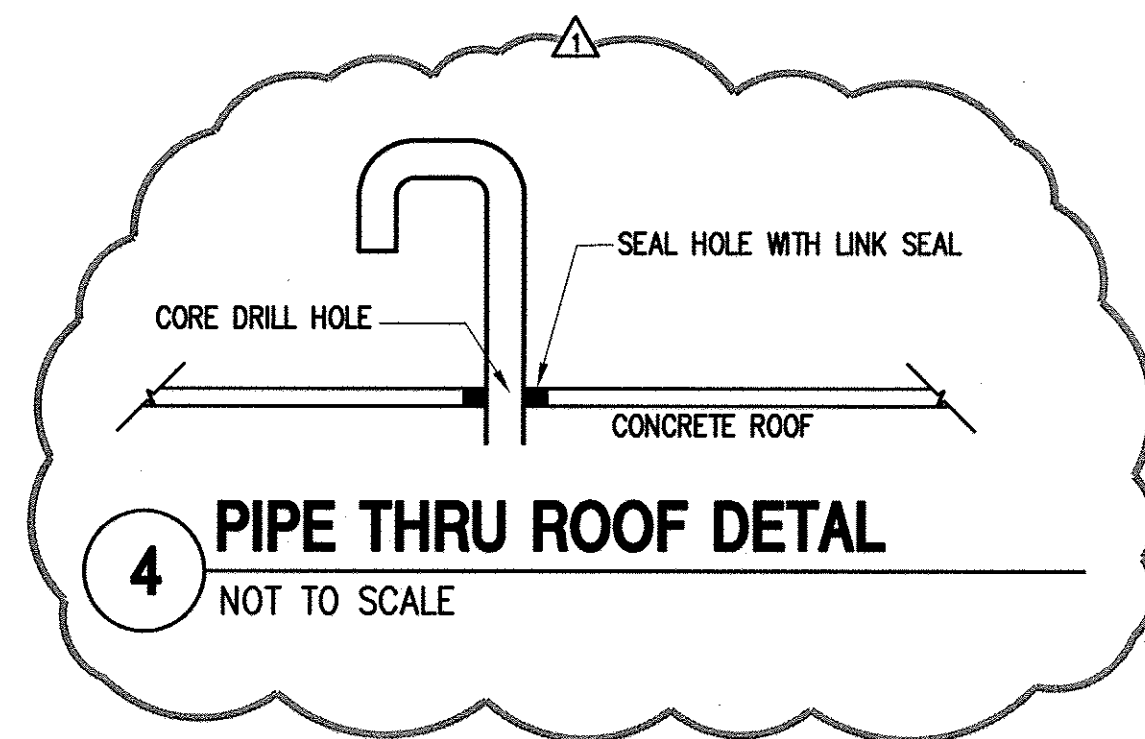
2 PIPING FOR DOUBLE SUCTION PUMP
CHILLED WATER, CONDENSING WATER
NOT TO SCALE

Vent Piping

Figure 12. Arrangement for rupture disc relief piping



3 ROOF MOUNTED EXHAUST FAN
NOT TO SCALE



4 PIPE THRU ROOF DETAIL
NOT TO SCALE

HVAC LEGEND

- EXISTING PIPING TO REMAIN
- EXISTING EQUIPMENT TO REMAIN
- - - EXISTING PIPING OR EQUIPMENT TO BE REMOVED
- - - EXISTING DUCTWORK TO REMAIN
- NEW EXHAUST DUCTWORK
- NEW DUCT MOUNTED RETURN AIR GRILLE
- ① KEYNOTE

AIR DEVICE SCHEDULE

TAG	SERVICE	MANUFACTURER AND MODEL	FACE SIZE	NECK SIZE	CFM	FINISH	MATERIAL	NOTES
A	RETURN	TITUS 350RL	16x16		900	WHITE	STEEL	

CODE ANALYSIS - REFRIGERATION ROOMS

PER 2000 UMC SECTION 1107 WITH CITY HOUSTON AMENDMENTS
Refrigeration room is existing; therefore section 1126 CITY HOUSTON AMENDMENTS applies.
Largest horsepower= 550 hp.
Chiller refrigerants are (group per table 11-1): chillers #1, 2, & 3: R11 (A1) and New Chiller #4: 134a (A1)
Quantity of largest refrigerant system: 1250 lb.
There is electrical switchgear in the room, but there are no clearance hazards with respect to the new chiller.
1126.9: existing ductwork in the mechanical room shall be sealed equipment shall be labeled per 1122.2

CONTINUOUS VENTILATION

- per 1108.2.2 (CITY HOUSTON AMENDMENTS): Continuous ventilation at .10 cfm/per ft x 3359 sq ft = 336cfm.
- per 11108.2.3 (CITY HOUSTON AMENDMENTS): Limit to 18 degree temp rise:
Total heat in the room is (using table 3A, chap 30, ASHRAE 2005 Fundamentals):
 - chillers, heat is negligible. Use 4,000. btuh
 - HVAC pumps: total 150 hp Use 57,470. btuh

TOTAL 61,470. btuh

Required Cfm= 61,470 / 18 / 1.08 = 3162 cfm
A new 3550 cfm exhaust fan will be designed.

EMERGENCY PURGE

- 1108.2.4 (CITY HOUSTON AMENDMENTS): Largest chiller has 1250 lbs of R-11
Emergency purge= 100 x sq root 1250 lbs = 3535 cfm
A new 3550 cfm exhaust fan will be designed.

DETECTION AND ALARMS

- 1121 (CITY HOUSTON AMENDMENTS)
Activation level: PEL of R-11 or R134A
LFL or IDLH criteria is not required since refrigerants are A1

SEQUENCE OF OPERATION

Refrigerant monitor shall automatically activate upon detection of a concentration of refrigerant vapor exceeding the PEL of R-11 or R134a.

Upon automatic monitor activation:

- Each audio and visual device activates and provide a distinctive sound pressure level 15dba above ambient sound pressure
- Visual alarms shall be both inside and outside each room exits
- Alarm is remotely annunciated by sending a signal to owner's energy mgmt system

Emergency ventilation:

- A. Emergency ventilation is being provided from fan F-27 & F-28 that run continuously.

MANUAL CONTROL OF VENTILATION SYSTEMS

1108.4 (CITY HOUSTON AMENDMENTS): Emergency ventilation fan shall be controlled by on-off switch (manual reset only) located inside the building within 24 inches of strike side of each exit door. Motorized dampers on existing OAI-9 shall be interlocked with Emergency ventilation fan

EMERGENCY CONTROLS OF OTHER PLANT ELECTRICAL EQUIPMENT

Per 1109.4 (CITY HOUSTON AMENDMENTS): not required since refrigerants are A1

REFRIGERANT RELIEF PIPING ALLOWABLE LENGTH CALCULATION USING ASHRAE 15-2007 - Appendix H (equation H-1)

PROJECT: WORTHAM CHILLER REPLACEMENT

CHILLER:

	CH-4	LBS AIR/MIN
EVAP 1 "Cr"	48	
COND 1 "Cr"	48	
COND 2 "Cr"	48	
Compressor 1 "Cr"	78	
Compressor 2 "Cr"	78	
TOTAL "Cr"	300	
RELIEF PRESS, PSIA (P0)	200	

FORMULA, ASHRAE 15-2007, Appendix H, eq. H-1

$$L = \frac{(0.2146d^5(P0^2 - P2^2)) / (f \cdot C_r^2)}{(d \ln(P0 - P2)) / 6f}$$

PIPE SIZE	INT DIAM (d)	MOODY FAC (f)	MAX LENGTH (FT)
1	1.049	0.0225	5
1.25	1.38	0.0209	23
1.5	1.61	0.0202	51
2	2.067	0.019	188
2.5	2.469	0.0182	478
3	3.068	0.0173	1490
4	4.026	0.0163	6156
5	5.047	0.0155	20041
6	6.065	0.0149	52247

L = equivalent length of discharge piping, ft
Cr = rated capacity as stamped on relief device (lb/min)
f = Moody friction factor in fully turbulent flow (given in piping table)
d = inside diameter of pipe or tube, inches
ln = natural log
P2 = Absolute Pressure at outlet of discharge piping (14.7 psi)
P0 = Allowed back pressure at the outlet of pressure relief device, psi (absolute)

PUMP SCHEDULE

PROJECT: WORTHAM CHILLER REPLACEMENT

TAG	CHWP-4	CWP-4
LOCATION	INDOOR	INDOOR
SERVICE	CHILLED	CONDENSER
TYPE	HORIZ	HORIZ
	SPLIT CASE	SPLIT CASE
	FRAME MOUNTED	FRAME MOUNTED
SPEED	CONSTANT	CONSTANT
FITTINGS	BRONZE	BRONZE
SEAL TYPE	MECH	MECH
SHAFT MATERIAL	CARBON STL	CARBON STL
FLOWRATE, GPM	408	575
HEAD, FT WATER	140	80
MIN EFF. AT DESIGN COND'NS	0.70	0.78
NOMINAL PUMP RPM	1800	1800
VOLTS / PH / CYCLES	460/3/60	460/3/60
MOTOR HORSEPOWER	40	20
NPSH	10.9	10.1
WORKING PRESSURE, PSIG	250	250

OPTIONS	CHWP-4	CWP-4
INERTIA BASE	YES	YES
PREMIUM EFF MOTOR	YES	YES
DRIP TRAP BASE WITH DRAIN	NO	NO
PROVIDE VFD WITH DISCONNECT	YES	YES
AURORA MODEL OR EQ.	MODEL 410, 3/4x14	MODEL 410, 1/2x14

NOTES:

- Pumps shall operate without vapor binding or cavitation
- Pumps shall be non-overloading
- Casing for pumps 3" x 4" and larger must accommodate an impeller 15 percent greater in diameter than the impeller that meets specified performance.

WATER COOLED CHILLER SCHEDULE

PROJECT: WORTHAM CHILLER REPLACEMENT

TAG	CH-4
QUANTITY	1
TYPE	SCREW
FLUID	WATER
DESIGN WORKING PRESSURE, PSI	150
MINIMUM PEAK CAPACITY, TONS	204.7
UNLOADING TO (% OF FULL LOAD)	25%
CHILLED WATER T, ENTERING	56
CHILLED WATER T, LVG	44
CHILLED WATER GPM	407.8
EVAP FOULING FACTOR	0.0001
MAX EVAP PRESS DROP, FT	15.1
NUMBER OF PASSES	2
COND WATER T, ENTERING	86
COND WATER T, LVG	96
COND WATER GPM	574.5
COND FOULING FACTOR	0.00025
MAX COND PRESS DROP, FT	19.5
NUMBER OF PASSES	2
MAXIMUM KW/TON, AT PROJECT CONDITIONS	0.640
MAXIMUM KW/TON, AT ARI CONDITIONS	0.630
MAXIMUM IPLV, AT ARI CONDITIONS	0.488
VOLTS/PH/CYCLES	460/3/60

CONNECTION LOCATIONS	NOTE 1
UNIT MOUNTED STARTER	YES
INTEGRAL DISCONNECT	YES
MARINE WATER BOXES	NO
VIB ISOLATION	YES
SINGLE POINT ELEC CONNECTION	YES
VAR FREQ DRIVE	NO
TRANE MODEL (OR APPROVED EQUAL)	RTMD

NOTE 1: CHILLED CONNECTIONS ARE ON THE SAME SIDE AS THE COND CONNECTIONS

FAN SCHEDULE

PROJECT: WORTHAM CHILLER REPLACEMENT

TAG	F-27	F-28
SERVICE	CONTINUOUS & EMERGENCY VENTILATION	TEMPERATURE CONTROLLED & EMERGENCY VENTILATION
AREA SERVED	CHILLER PLANT	CHILLER PLANT
FAN TYPE	CENTRIFUGAL - UPBLAST	CENTRIFUGAL - UPBLAST
AIR FLOW CFM	1775	1775
EXT. STATIC PRES	0.6	0.6
DRIVE	DIRECT	DIRECT
MOTOR DATA (HP)	1/2	1/2
VOLTS/PH/CYCLES	460/3/60	460/3/60
ACCESSORIES		
FACTORY DISCONNECT	YES	YES
BACK DRAFT DAMPER	YES	YES
FAN SPEED SWITCH	NO	1
NOTES	CUE-121-A	CUE-121-A

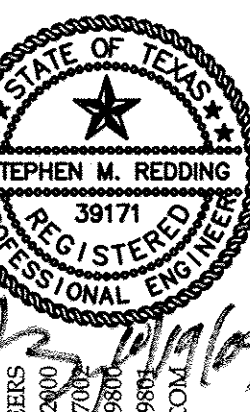
1. FAN TO RUN CONTINUOUSLY
2. PROVIDE VFD WITH DISCONNECT AND WEATHERPROOF ENCLOSURE

ISSUE FOR REVIEW
12/03/2008

ISSUE FOR PERMIT
07/21/2009

ADDENDUM #1
10/19/2009

WORTHAM THEATER CENTER
CHILLER REPLACEMENT
HOUSTON, TEXAS



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PROJECT NUMBER
08171.00

DRAWN BY
JPW

CHECKED BY
SMR

SHEET DATE
06/30/09

M3.0